The efficient buying, storing, and handling of the raw material of an industry, while they are very important, and will reduce the cost of manufacture, are at best a saving effected on a very small percentage of the total human effort expended in industry. If we realise that everything that man makes is consumed, sooner or later, then we may consider all the products of each industry to be the raw material of another industry. Production we can conceive as the evolution of raw material from a simple to a more and more complex product. Each time it is sold, bought, and stored in the process, we may consider its growth temporarily stopped. It is during this time of lack of change, when the very minimum of human effort is expended on it, that we try to save human effort. During all the numerous definite changes of the product, when the maximum of human effort is expended, we refuse to apply scientific principles. Considering that this is the application of science which affects by far the greatest number of workers, it is very easy to comprehend their opposition to being "Taylorised," as they say.

The "Taylor" method accepts no preconceived ideas of how a job should be done. As a chemist splits up a compound into its elements, so Dr. Taylor says that all jobs should be split up into their elemental operations. These elemental operations are carefully studied and timed by engineer experts, and the useless ones, which we may consider as impurities, are eliminated. The best machine tools and equipment are used, and, therefore, standard minimum times can be found for all standard operations. When data are accumulated giving the time required for standard specified machine work, fitting, etc., then standard operation times can be fixed from the drawings without any timing in the shops, just as the designs themselves may be made without shop experiments. "Time" or "motion" study is scientific in its method, and the accuracy of the result will like all experimental data, depend on the accuracy of the observer. There are definite principles in this "Taylor" method which, when grasped by experts, can be used by them to arrive at accurate results. All other methods of "rate-setting" are non-scientific. Some are pure guess-work, some are more or less so.

The "fatigue factor," which is the time to be allowed in addition to the "standard" time, so that the worker may not be "fatigued," is most difficult to discover accurately; but for this, science is as much at fault as industry. Medical science formerly concerned itself almost entirely with the cure of disease, but it now devotes itself largely to cause and prevention. When we all realise that disease must be prevented, we shall soon begin to realise that industrial fatigue must also be prevented. The "Taylor" system is the only one that separates out the work and fatigue of production, like the analysis of useful work and losses in a machine. It remains for the scientific experts, the engineers, the doctors, and the psychologists to co-operate and co-ordinate their efforts so as to produce as scientifically accurate a result as their combined efforts make possible, and to keep it continually up-to-date as methods improve and knowledge extends.

Dr. Taylor says that the workers must be instructed in the principles of their art by the management, and not left to learn it from others as they see fit. This necessitates that the management should be organised on a functional basis. Brains must be specialised and trained just the same as manual labour, and, therefore, the system does away with the old orthodox foreman and his assistants and under-assistants, and he creates many foremen, each of whom has one specific function, in which he is an expert. The "Taylor" system separates the functions of planning, instruction, and execution. It increases the cost and the size of the management, and greatly increases its responsibility. That is why so few employers will adopt it. It requires much more care, study, and thought than any arbitrary, non-scientific system.

The trade-unions and the men oppose the system because it will not use individual and trade habits and prejudices unless they happen to be scientifically sound. While this attitude excuses the workers, it betrays a lack of vision on the part of the "intellectuals" in the Labour movement, who, so far, are unable to see that the elimination of the enormous amount of useless effort put forth by the working classes must be to the benefit of that class more than any other.

It is the same old battle of knowledge against ignorance and prejudice. Patience, sympathy, and much more education are required. Not education which will give to more and more little uncorrelated scraps of chemistry, physics, and electricity, but an education which will train the mind to think in a scientific manner and grasp the significance of the interdependence of all things, and most especially human effort. If we are to maintain our position as one of the greatest of the world-States, intelligently directed effort on the part of everyone will be obligatory. The same energy put into useful work as is now wasted in useless effort will not only double and treble our production of material wealth, but it will also ease the burden on the workers and enable them to live freer, higher, and happier lives.

J. M. SCOTT-MAXWELL.

GERMAN INDUSTRY AFTER THE WAR.

III.

MM. JAUREGUY, FROMENT, AND STEPHEN conclude their series of communications to the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* (see NATURE for September 26 and October 3) on the influence of the war on German industry with some interesting reflections on its after-effects, temporary and permanent. There can be no doubt that the isolation of Germany for so long a period has occasioned profound modifications in her industrial and commercial position. Whatever may be the ultimate result of the struggle, she no longer hopes for the victory on which, at the outset, she confidently reckoned. All her energies are now directed to avert or to minimise the disastrous consequences which await her. The era of peaceful penetration is at an end. She realises that she has incurred a world-wide hatred, and that the world's markets are no longer open to her on pre-war terms. Moreover, she is face to face with an unlooked-for and astonishing development on the part of her most powerful enemies of those industries in which she was supreme, and which she trusts may still enable her to recover, to some extent, her lost position. These industries, indeed, are the main means by which she hopes to get over her immediate financial difficulties, to retrieve her commercial credit, and so enable her to purchase the enormous supplies of raw materials of which she is in urgent need.

A very few months after the outbreak of hostilities the leaders of German industry realised the seriousness of their position, and during the middle of 1915 they began to take steps in order to meet the difficulties in front of them. Political reasons compelled the State to delay for a time any public recognition of their apprehensions, but in the late summer of 1916 the Government created an Imperial Commission to study and report upon what was termed the "Economics of Transition," or, in other words, the most feasible means of passing from the economic life of war to the economic life of peace. The Commission consisted of certain State functionaries with a technical staff composed of qualified representatives of every important branch of German industry. Its duties were to consider the best means of regulating the purchase of foreign material, and, as a consequence, to study the question of exchange, to regulate the transport of the merchandise thus bought—that is, the question of freight—to regulate the distribution of imported raw material, and, lastly, to decide upon the most effective means of recovering over-sea traffic.

The discussion of these questions greatly agitated commercial and industrial circles during 1916 and 1917, and roused many conflicting interests. The difficulty was to determine which industries should receive preferential treatment, for it was obvious that these regulations would inevitably strike at the root of all freedom of commerce. The main ideas which seemed to guide the Commission, acting in the general interests of the State, were to develop as rapidly as possible the exportation of products for which presumably there would be an urgent demand, and which, therefore, were commercially the most valuable, such as synthetic dyes and pharmaceutical products; to prevent all importation of dispensable material; to manufacture as rapidly as possible raw materials into products that might be re-exported with the shortest possible delay; and to import the largest possible quantities of food and forage.

As may be imagined, particular industries at once began to urge their right to preferential treatment. It was practically impossible to settle their claims on any intelligible or rational basis. Moreover, many economists viewed the interference of the bureaucracy in matters of commerce with considerable distrust. The great purchasing organisation which was contemplated foreboded a State monopoly. The regulation of imports and exports seemed to strike at the prosperity of Hamburg and Bremen, and the shipping interest protested. Commercial freedom, they insisted, could alone save the country.

Concurrently with all this unrest there was a growing feeling of dissatisfaction with the working of the numerous war societies which the Government had called into existence and placed under the direction of various Ministers of State. By the middle of 1917 these numbered about 250, and were directed solely to the interests of the Army and the war. They proved exceedingly irksome to the commercial classes as a whole, and were at times of great inconvenience and even hardship to the workers, who were moved about from place to place, like so many pawns in a game, as the necessities of the war seemed to demand. By the end of 1916 the Imperial Chancellor had decreed what was, in fact, a civil mobilisation. Certain industries were forcibly taken over by the State, such as the manufacture of soap and of boots and shoes. In the latter case the tanning and leather industries raised a violent protest, and the reaction—it was virtually a revolution—spread throughout Germany. A syndicate such as was contemplated by the Government would mean the eventual ruin of their export trade. One manufacturer thus expressed himself: "The war has shown how much we as a nation are detested by the foreigner and regarded as barbarians. Merchandise launched upon the world's markets after the war by a State syndicate would meet with the greatest opposition, whereas goods offered by old commercial friends who are known personally, through commercial relations established for years, and are not looked upon as barbarians, would be received in a very different spirit."

The arguments of the traders met with an echo in the Reichstag. The syndicates were warmly defended as provisional measures by ex-Vice-Chancellor Helfferich, and supported by State-Secretary Schwander. Ex-Chancellor Michaelis went even further: they were, he said, a fiscal necessity, and must exist after the war as State monopolies, in view of the enormous financial needs of the Empire. In this declaration the industrial community saw the justification of its fears and the necessity for its action. The opposition was thereby strengthened, and in the end the Government capitulated.

There are two great branches of industry on which Germany sets great store, and which she hopes may do much to rehabilitate her commercial position after the war. The one is the synthetic colour trade and the affiliated manufacture of pharmaceutical products; the other is the potash industry, of which she had practically a monopoly.

As regards the first, she is striving by every means to maintain her ascendancy. Not only have the great colour-producing concerns banded themselves together to work in common and pool their profits, they have also taken steps to assure themselves of a continued and, indeed, increased supply of the trained material upon which the ultimate success and development of their industry depend. This they have sought to further by the establishment of scholarships or bursaries, known as the Liebig bursaries, to be awarded to deserving young chemists who have graduated at the polytechnics, on condition that they serve as assistants to the professors and are trained in the work of research. The necessary capital of 2 million marks to found these bursaries has been entirely subscribed by the leading colour-makers. Similar action has been taken by the Technico-scientific Union, which acts as an intermediary between industry and the scientific departments of the universities and the polytechnics, and arranges for the investigation of special problems which the smaller or less wealthy industrial concerns may desire to have solved. There is also an organisation known as the "Society of Friends and Benefactors of the Rhenish University of Bonn," which seeks to make generally known the knowledge acquired during the war in the domains of agriculture, commerce, and industry, and to further their progress by the active collaboration of science and industry. These instances are remarkable as indicating that Germany is at length seeking to emancipate itself in educational matters from official thraldom. Hitherto efforts of this kind have been largely initiated or controlled by State authority. It is curious that whilst that country as the result of war-experience is moving towards a more democratic control in this matter, our own action in national educational effort as the outcome of the same experience tends more and more towards bureaucratic direction.

The Stassfurt potash deposits are, no doubt, a great German asset. Prof. Ostwald, indeed, has declared that it rests with Germany to decide if in the future the world is to be nourished or starved. Four years' experience will, however, convince most people that the learned professor's assertion is on a par with much of the rodomontade to which he has accustomed us. There are many signs that the German potash monopoly will be broken, and, as Mr. Kenneth Chance has shown in the paper which he read at the recent annual meeting of the Society of Chemical Industry, the production of potash in this country is far from being an insoluble problem. With the passing of Alsace to France, Germany's control of the main supply will be jeopardised. Moreover, there are other untapped sources throughout the world. It has been asserted that the chance of finding soluble potash in British geological deposits is at least as great as that of discovering mineral oil. What is wanted is a systematic scheme of exploration which has never yet been attempted. There is no *a priori* reason why the conditions which have led to the creation of the German deposits should be confined to that country. It seems only yesterday that such deposits were discovered in Alsace, and what has happened in Alsace may well be found to have occurred elsewhere.

DR. HENRY DYER.

With the death of Dr. Henry Dyer on September 25, there passes from our midst, at the age of seventy, one whose name will ever be associated with the rise of Japan as an industrial Power. He had barely finished his distinguished student career in the University of Glasgow when, on the recommendation of Prof. Macquorn Rankine, he was appointed principal of the newly constituted Kobu Daigakko or College of Engineering in Tokyo. This was in 1872, when he was only twenty-four years of age. An account of the college in these early days will be found in Nature, vol. xvi., p. 44 (May, 1877), and its marked success as an educational institution up to the date of its amalgamation in 1886 with the Teikoku Daigaku or Imperial University of Tokyo was an eloquent tribute to the clearness of purpose and the organising skill of its first principal.

In considering the part Dyer played in this great venture we should bear in mind not only his own direct work, but also the remarkable staff of young professors he gathered round him. Most of these he outlived, such as Ayrton, the electrician; Edward Divers, the chemist; John Milne, the seismologist; and C. D. West, the engineer, a man of the wide culture so characteristic of the graduates of Trinity College, Dublin. Prof. John Perry and Prof. Thomas Alexander are still with us, as are also two of the professors of English, the Rev. W. G. Dixon, now of Dunedin, and Prof. J. M. Dixon, of the University of South California, Los Angeles. The inclusion of English as an essential subject of study in the engineering curriculum showed the far-sighted policy of the early organisers of the college. From within its walls there went forth a great body of graduates to whom English was almost a second mother tongue, so well were they trained in the use of our idiom and in the knowledge of our best books. Many of these graduates held important Government posts, and their influence must have been considerable in shaping Japan's destinies.

After ten years of strenuous work Henry Dyer retired from the principalship and settled in Glasgow, where he soon identified himself with progressive educational developments. He threw himself with characteristic ardour into the organisation of what is now the Royal Technical College, of which he was a life governor. He became a member of the Glasgow School Board in 1891, and had acted as chairman since 1914. He was particularly interested in the work of the continuation classes and in the difficult problems of industrial reconstruction and education. As deputy-chairman of the Board of Conciliation and Arbitration of the Manufactured